



Cathedral Energy Services

Survey Report

Company:	EnCana Oil & Gas (USA) Inc	Local Co-ordinate Reference:	Well Billings 1A-34H
Project:	DJ Wattenberg	TVD Reference:	WELL @ 5008.0ft (Ensign 135)
Site:	S34-T2N-R68W (Billings)	MD Reference:	WELL @ 5008.0ft (Ensign 135)
Well:	Billings 1A-34H	North Reference:	True
Wellbore:	Hz	Survey Calculation Method:	Minimum Curvature
Design:	FINAL	Database:	USA EDM 5000 Multi Users DB

Project	DJ Wattenberg		
Map System:	US State Plane 1983	System Datum:	Mean Sea Level
Geo Datum:	North American Datum 1983		
Map Zone:	Colorado Northern Zone		

Site		S34-T2N-R68W (Billings)			
Site Position:		Northing:	1,280,284.39 ft	Latitude:	40.101620
From:	Lat/Long	Easting:	3,143,887.76 ft	Longitude:	-104.985650
Position Uncertainty:	0.0 ft	Slot Radius:	13.200 in	Grid Convergence:	0.33 °

Well		Billings 1A-34H				
Well Position	+N/-S	0.0 ft	Northing:	1,280,284.38 ft	Latitude:	40.101620
	+E/-W	0.0 ft	Easting:	3,143,887.76 ft	Longitude:	-104.985650
Position Uncertainty		0.0 ft	Wellhead Elevation:	ft	Ground Level:	4,995.0 ft

Wellbore	Hz				
Magnetics	Model Name	Sample Date	Declination (°)	Dip Angle (°)	Field Strength (nT)
	IGRF2010	10/15/2013	8.64	66.69	52,704

Design	FINAL				
Audit Notes:					
Version:	1.0	Phase:	ACTUAL	Tie On Depth:	0.0
Vertical Section:	Depth From (TVD)	+N/-S (ft)	+E/-W (ft)	Direction (°)	
	0.0	0.0	0.0	180.00	

Survey Program	Date	10/23/2013			
From (ft)	To (ft)	Survey (Wellbore)	Tool Name	Description	
144.0	12,295.0	Survey #1 (Hz)	Geolink MWD	Geolink MWD	

Survey										
Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Formations / Comments	
0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00		
144.0	0.20	113.20	144.0	-0.1	0.2	0.1	0.14	0.14		
236.0	1.70	324.20	236.0	0.9	-0.4	-0.9	2.04	1.63		
297.0	2.30	324.60	296.9	2.7	-1.7	-2.7	0.98	0.98		
359.0	3.00	307.60	358.9	4.7	-3.7	-4.7	1.69	1.13		
420.0	3.60	299.00	419.8	6.6	-6.6	-6.6	1.27	0.98		
512.0	4.40	295.90	511.6	9.5	-12.3	-9.5	0.90	0.87		
603.0	5.20	281.00	602.2	11.8	-19.5	-11.8	1.62	0.88		
695.0	6.00	277.90	693.8	13.3	-28.3	-13.3	0.93	0.87		
788.0	6.80	282.60	786.2	15.2	-38.5	-15.2	1.03	0.86		
879.0	6.80	285.20	876.6	17.7	-49.0	-17.7	0.34	0.00		
971.0	7.10	282.30	967.9	20.4	-59.8	-20.4	0.50	0.33		
995.0	7.00	283.40	991.7	21.0	-62.7	-21.0	0.70	-0.42		
1,099.0	8.30	283.60	1,094.8	24.3	-76.1	-24.3	1.25	1.25		

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Wellbore:	Hz	Survey Calculation Method:	Minimum Curvature
Design:	FINAL	Database:	USA EDM 5000 Multi Users DB

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1,191.0	10.90	288.20	1,185.5	28.6	-90.9	-28.6	2.94	2.83	
1,283.0	10.80	288.30	1,275.9	34.0	-107.3	-34.0	0.11	-0.11	
1,374.0	10.60	280.60	1,365.3	38.2	-123.6	-38.2	1.59	-0.22	
1,466.0	10.20	280.10	1,455.8	41.2	-140.0	-41.2	0.45	-0.43	
1,558.0	11.60	281.60	1,546.1	44.5	-157.0	-44.5	1.55	1.52	
1,650.0	10.80	276.90	1,636.4	47.4	-174.7	-47.4	1.32	-0.87	
1,742.0	10.50	286.20	1,726.8	50.7	-191.3	-50.7	1.89	-0.33	
1,834.0	10.40	283.90	1,817.3	55.1	-207.4	-55.1	0.47	-0.11	
1,926.0	10.30	281.50	1,907.8	58.7	-223.5	-58.7	0.48	-0.11	
2,021.0	11.10	276.90	2,001.1	61.5	-240.9	-61.5	1.23	0.84	
2,115.0	11.00	287.50	2,093.4	65.3	-258.4	-65.3	2.16	-0.11	
2,210.0	10.90	286.50	2,186.6	70.6	-275.7	-70.6	0.23	-0.11	
2,305.0	10.50	285.80	2,280.0	75.5	-292.6	-75.5	0.44	-0.42	
2,399.0	9.80	283.80	2,372.5	79.7	-308.7	-79.7	0.83	-0.74	
2,494.0	11.00	288.70	2,466.0	84.5	-325.1	-84.5	1.57	1.26	
2,588.0	10.40	286.60	2,558.3	89.8	-341.7	-89.8	0.76	-0.64	
2,683.0	9.50	285.10	2,651.9	94.3	-357.5	-94.3	0.99	-0.95	
2,777.0	11.00	292.10	2,744.4	99.7	-373.3	-99.7	2.07	1.60	
2,872.0	10.40	291.00	2,837.7	106.2	-389.7	-106.2	0.67	-0.63	
2,967.0	9.60	290.20	2,931.3	112.0	-405.1	-112.0	0.85	-0.84	
3,061.0	11.30	285.40	3,023.7	117.2	-421.4	-117.2	2.03	1.81	
3,156.0	10.50	285.30	3,117.0	121.9	-438.7	-121.9	0.84	-0.84	
3,251.0	9.80	283.60	3,210.5	126.1	-454.9	-126.1	0.80	-0.74	
3,345.0	10.10	282.20	3,303.1	129.7	-470.7	-129.7	0.41	0.32	
3,440.0	11.30	280.00	3,396.5	133.1	-488.1	-133.1	1.33	1.26	
3,535.0	10.30	288.20	3,489.8	137.4	-505.3	-137.4	1.93	-1.05	
3,629.0	11.60	289.00	3,582.1	143.1	-522.2	-143.1	1.39	1.38	
3,724.0	10.90	286.50	3,675.3	148.7	-539.8	-148.7	0.90	-0.74	
3,819.0	11.30	287.30	3,768.5	154.1	-557.3	-154.1	0.45	0.42	
3,914.0	12.30	283.20	3,861.5	159.1	-576.1	-159.1	1.37	1.05	
4,009.0	11.70	282.10	3,954.4	163.5	-595.4	-163.5	0.68	-0.63	
4,103.0	11.30	288.60	4,046.5	168.4	-613.4	-168.4	1.44	-0.43	
4,198.0	11.60	289.90	4,139.6	174.6	-631.2	-174.6	0.42	0.32	
4,293.0	12.00	291.10	4,232.6	181.4	-649.4	-181.4	0.49	0.42	
4,387.0	11.20	288.40	4,324.7	187.8	-667.2	-187.8	1.03	-0.85	
4,482.0	10.10	286.50	4,418.1	193.1	-683.9	-193.1	1.22	-1.16	
4,577.0	9.30	286.10	4,511.7	197.6	-699.3	-197.6	0.85	-0.84	
4,671.0	8.80	285.60	4,604.5	201.6	-713.5	-201.6	0.54	-0.53	
4,766.0	8.30	286.70	4,698.5	205.6	-727.1	-205.6	0.55	-0.53	
4,861.0	5.10	280.40	4,792.8	208.3	-737.8	-208.3	3.45	-3.37	
4,955.0	3.80	279.90	4,886.5	209.6	-745.0	-209.6	1.38	-1.38	
5,050.0	3.60	278.90	4,981.3	210.6	-751.0	-210.6	0.22	-0.21	
5,145.0	1.70	293.90	5,076.2	211.6	-755.3	-211.6	2.11	-2.00	
5,240.0	1.30	249.90	5,171.2	211.8	-757.6	-211.8	1.25	-0.42	
5,334.0	1.30	251.00	5,265.2	211.1	-759.6	-211.1	0.03	0.00	
5,429.0	1.20	247.90	5,360.1	210.4	-761.5	-210.4	0.13	-0.11	
5,524.0	0.90	238.80	5,455.1	209.6	-763.1	-209.6	0.36	-0.32	
5,619.0	0.70	242.20	5,550.1	209.0	-764.2	-209.0	0.22	-0.21	
5,714.0	0.40	212.80	5,645.1	208.4	-764.9	-208.4	0.42	-0.32	
5,808.0	0.50	234.30	5,739.1	207.9	-765.4	-207.9	0.21	0.11	
5,903.0	0.40	192.30	5,834.1	207.3	-765.8	-207.3	0.35	-0.11	
5,998.0	0.00	103.40	5,929.1	207.0	-765.9	-207.0	0.42	-0.42	
6,093.0	0.40	66.80	6,024.1	207.2	-765.6	-207.2	0.42	0.42	
6,188.0	0.50	58.00	6,119.1	207.5	-764.9	-207.5	0.13	0.11	

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Measured Depth (ft)	Inclination (°)	Azimuth (°)	Vertical Depth (ft)	+N/-S (ft)	+E/-W (ft)	Vertical Section (ft)	Dogleg Rate (°/100ft)	Build Rate (°/100ft)	Formations / Comments
6,282.0	0.40	17.00	6,213.1	208.0	-764.5	-208.0	0.35	-0.11	
6,377.0	0.40	45.30	6,308.1	208.6	-764.2	-208.6	0.21	0.00	
6,472.0	0.50	54.40	6,403.1	209.1	-763.6	-209.1	0.13	0.11	
6,566.0	0.40	10.20	6,497.1	209.6	-763.2	-209.6	0.37	-0.11	
6,661.0	1.00	181.00	6,592.1	209.1	-763.2	-209.1	1.47	0.63	
6,756.0	1.10	167.10	6,687.1	207.4	-763.0	-207.4	0.29	0.11	
6,850.0	1.10	133.30	6,781.1	205.9	-762.1	-205.9	0.68	0.00	
6,945.0	0.50	300.00	6,876.1	205.5	-761.8	-205.5	1.67	-0.63	
7,040.0	0.30	312.00	6,971.0	205.9	-762.4	-205.9	0.23	-0.21	
7,135.0	0.40	277.80	7,066.0	206.1	-762.9	-206.1	0.24	0.11	
7,166.0	2.40	198.00	7,097.0	205.5	-763.2	-205.5	7.62	6.45	
7,198.0	7.00	186.60	7,128.9	202.9	-763.6	-202.9	14.60	14.37	
7,229.0	11.50	182.80	7,159.5	197.9	-764.0	-197.9	14.64	14.52	
7,261.0	15.10	181.60	7,190.6	190.6	-764.2	-190.6	11.28	11.25	
7,293.0	17.50	182.30	7,221.4	181.6	-764.6	-181.6	7.52	7.50	
7,324.0	20.00	182.00	7,250.7	171.6	-764.9	-171.6	8.07	8.06	
7,356.0	22.10	181.90	7,280.6	160.2	-765.3	-160.2	6.56	6.56	
7,387.0	24.90	182.00	7,309.0	147.8	-765.7	-147.8	9.03	9.03	
7,419.0	27.60	181.30	7,337.7	133.7	-766.1	-133.7	8.49	8.44	
7,450.0	30.60	180.50	7,364.8	118.6	-766.4	-118.6	9.76	9.68	
7,482.0	33.50	179.70	7,391.9	101.6	-766.4	-101.6	9.16	9.06	
7,514.0	35.80	179.20	7,418.2	83.4	-766.2	-83.4	7.24	7.19	
7,545.0	37.30	179.40	7,443.1	64.9	-766.0	-64.9	4.85	4.84	
7,577.0	40.10	180.00	7,468.1	44.9	-765.9	-44.9	8.83	8.75	
7,608.0	43.60	181.50	7,491.2	24.3	-766.2	-24.3	11.74	11.29	
7,640.0	47.60	182.90	7,513.6	1.4	-767.1	-1.4	12.88	12.50	
7,672.0	51.00	183.70	7,534.4	-22.8	-768.5	22.8	10.79	10.62	
7,703.0	52.00	185.10	7,553.7	-47.0	-770.3	47.0	4.79	3.23	
7,735.0	53.50	184.70	7,573.1	-72.4	-772.5	72.4	4.79	4.69	
7,766.0	56.70	182.80	7,590.8	-97.7	-774.2	97.7	11.48	10.32	
7,798.0	60.80	179.80	7,607.4	-125.1	-774.8	125.1	15.11	12.81	
7,829.0	65.80	178.00	7,621.4	-152.7	-774.2	152.7	16.94	16.13	
7,861.0	68.40	177.30	7,633.8	-182.2	-773.0	182.2	8.37	8.12	
7,893.0	69.80	177.40	7,645.2	-212.1	-771.6	212.1	4.38	4.37	
7,903.0	70.50	177.60	7,648.6	-221.4	-771.2	221.4	7.25	7.00	
7,949.0	75.60	179.10	7,662.0	-265.4	-770.0	265.4	11.52	11.09	
7,981.0	78.00	179.80	7,669.3	-296.6	-769.7	296.6	7.80	7.50	
8,013.0	80.70	181.30	7,675.3	-328.0	-770.0	328.0	9.61	8.44	
8,044.0	84.30	181.80	7,679.3	-358.7	-770.8	358.7	11.72	11.61	
8,076.0	87.70	181.90	7,681.5	-390.6	-771.8	390.6	10.63	10.62	
8,107.0	90.10	182.00	7,682.1	-421.6	-772.9	421.6	7.75	7.74	
8,202.0	89.50	180.50	7,682.5	-516.6	-775.0	516.6	1.70	-0.63	
8,297.0	90.80	180.50	7,682.2	-611.6	-775.8	611.6	1.37	1.37	
8,392.0	91.20	181.10	7,680.6	-706.5	-777.1	706.5	0.76	0.42	
8,486.0	90.20	181.20	7,679.4	-800.5	-779.0	800.5	1.07	-1.06	
8,581.0	90.80	180.80	7,678.6	-895.5	-780.7	895.5	0.76	0.63	
8,676.0	89.70	181.20	7,678.2	-990.5	-782.3	990.5	1.23	-1.16	
8,771.0	88.90	179.50	7,679.3	-1,085.5	-782.9	1,085.5	1.98	-0.84	
8,865.0	88.30	179.40	7,681.6	-1,179.4	-782.0	1,179.4	0.65	-0.64	
8,960.0	88.50	179.20	7,684.3	-1,274.4	-780.8	1,274.4	0.30	0.21	
9,054.0	88.50	178.40	7,686.7	-1,368.3	-778.9	1,368.3	0.85	0.00	
9,149.0	88.70	178.90	7,689.1	-1,463.3	-776.6	1,463.3	0.57	0.21	
9,244.0	89.00	179.10	7,691.0	-1,558.3	-775.0	1,558.3	0.38	0.32	
9,339.0	89.20	178.80	7,692.5	-1,653.2	-773.2	1,653.2	0.38	0.21	

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9,433.0	88.30	178.40	7,694.5	-1,747.2	-770.9	1,747.2	1.05	-0.96	
9,528.0	88.90	178.30	7,696.8	-1,842.1	-768.2	1,842.1	0.64	0.63	
9,623.0	90.20	179.40	7,697.6	-1,937.1	-766.3	1,937.1	1.79	1.37	
9,718.0	90.70	179.60	7,696.8	-2,032.1	-765.5	2,032.1	0.57	0.53	
9,812.0	91.50	180.30	7,695.0	-2,126.1	-765.4	2,126.1	1.13	0.85	
9,907.0	91.10	179.90	7,692.9	-2,221.0	-765.5	2,221.0	0.60	-0.42	
10,002.0	90.90	180.60	7,691.2	-2,316.0	-766.0	2,316.0	0.77	-0.21	
10,097.0	90.20	180.30	7,690.3	-2,411.0	-766.7	2,411.0	0.80	-0.74	
10,192.0	90.40	180.20	7,689.8	-2,506.0	-767.1	2,506.0	0.24	0.21	
10,287.0	89.50	179.50	7,689.9	-2,601.0	-766.9	2,601.0	1.20	-0.95	
10,381.0	89.00	179.40	7,691.1	-2,695.0	-766.0	2,695.0	0.54	-0.53	
10,476.0	89.80	179.50	7,692.1	-2,790.0	-765.1	2,790.0	0.85	0.84	
10,571.0	89.70	179.90	7,692.5	-2,885.0	-764.6	2,885.0	0.43	-0.11	
10,666.0	86.70	179.80	7,695.5	-2,979.9	-764.3	2,979.9	3.16	-3.16	
10,760.0	88.30	180.60	7,699.6	-3,073.8	-764.6	3,073.8	1.90	1.70	
10,855.0	89.50	181.40	7,701.4	-3,168.8	-766.3	3,168.8	1.52	1.26	
10,950.0	90.90	182.00	7,701.1	-3,263.7	-769.1	3,263.7	1.60	1.47	
11,013.0	91.40	181.60	7,699.8	-3,326.7	-771.1	3,326.7	1.02	0.79	
11,076.0	89.90	180.60	7,699.1	-3,389.7	-772.3	3,389.7	2.86	-2.38	
11,139.0	86.60	178.80	7,701.0	-3,452.6	-772.0	3,452.6	5.97	-5.24	
11,234.0	87.40	179.10	7,706.0	-3,547.5	-770.2	3,547.5	0.90	0.84	
11,328.0	88.30	179.10	7,709.5	-3,641.4	-768.8	3,641.4	0.96	0.96	
11,423.0	88.00	179.70	7,712.6	-3,736.4	-767.8	3,736.4	0.71	-0.32	
11,518.0	88.70	179.30	7,715.3	-3,831.3	-766.9	3,831.3	0.85	0.74	
11,612.0	89.00	180.20	7,717.2	-3,925.3	-766.5	3,925.3	1.01	0.32	
11,707.0	89.10	181.80	7,718.8	-4,020.3	-768.2	4,020.3	1.69	0.11	
11,802.0	89.30	182.40	7,720.1	-4,115.2	-771.7	4,115.2	0.67	0.21	
11,897.0	88.70	181.30	7,721.8	-4,210.1	-774.7	4,210.1	1.32	-0.63	
11,992.0	88.10	181.30	7,724.4	-4,305.1	-776.9	4,305.1	0.63	-0.63	
12,086.0	87.60	181.50	7,728.0	-4,399.0	-779.2	4,399.0	0.57	-0.53	
12,181.0	87.40	181.80	7,732.1	-4,493.8	-781.9	4,493.8	0.38	-0.21	
12,246.0	88.10	181.90	7,734.7	-4,558.8	-784.0	4,558.8	1.09	1.08	Last Cathedral Survey @ 12,246' MD Projection to bit @ 12,295' MD
12,295.0	88.10	181.90	7,736.3	-4,607.7	-785.6	4,607.7	0.00	0.00	

Cathedral Energy Services

Survey Report

Company:	EnCana Oil & Gas (USA) Inc	Local Co-ordinate Reference:	Well Billings 1A-34H
Project:	DJ Wattenberg	TVD Reference:	WELL @ 5008.0ft (Ensign 135)
Site:	S34-T2N-R68W (Billings)	MD Reference:	WELL @ 5008.0ft (Ensign 135)
Well:	Billings 1A-34H	North Reference:	True
Wellbore:	Hz	Survey Calculation Method:	Minimum Curvature
Design:	FINAL	Database:	USA EDM 5000 Multi Users DB

Targets									
Target Name									
- hit/miss target	Dip Angle	Dip Dir.	TVD	+N/-S	+E/-W	Northing	Easting	Latitude	Longitude
- Shape	(°)	(°)	(ft)	(ft)	(ft)	(ft)	(ft)		
Billings 1A-34H TGT 2	0.00	0.00	7,694.0	-3,186.7	-776.4	1,277,093.23	3,143,129.91	40.092872	-104.988425
- actual wellpath misses target center by 12.2ft at 10873.2ft MD (7701.5 TVD, -3187.0 N, -766.8 E)									
- Point									
Billings 1A-34H PBHL P:	0.00	0.00	7,744.0	-4,622.7	-778.2	1,275,657.27	3,143,136.39	40.088930	-104.988431
- actual wellpath misses target center by 18.4ft at 12295.0ft MD (7736.3 TVD, -4607.7 N, -785.6 E)									
- Point									
Billings 1A-34H TGT 1	0.00	0.00	7,694.0	-1,586.7	-774.3	1,278,693.21	3,143,122.68	40.097264	-104.988418
- actual wellpath misses target center by 2.6ft at 9272.5ft MD (7691.4 TVD, -1586.7 N, -774.5 E)									
- Point									
Billings 1A-34H PBHL N:	0.00	0.00	7,649.0	-4,622.7	-778.2	1,275,657.27	3,143,136.39	40.088930	-104.988431
- actual wellpath misses target center by 88.9ft at 12295.0ft MD (7736.3 TVD, -4607.7 N, -785.6 E)									
- Point									

Design Annotations					
Measured Depth	Vertical Depth	Local Coordinates			
(ft)	(ft)	+N/-S (ft)	+E/-W (ft)	Comment	
12,246.0	7,734.7	-4,558.8	-784.0	Last Cathedral Survey @ 12,246' MD	
12,295.0	7,736.3	-4,607.7	-785.6	Projection to bit @ 12,295' MD	

Checked By: _____ Approved By: _____ Date: _____